CHARACTERISTICS OF RECENT VOLCANIC ERUPTIONS.[1]

THERE is a remarkable similarity between the islands of St. Vincent and Martinique. Both are roughly oval in form, with the long axis almost north and south. The north-west portion of each is occupied by a volcano, the Soufrière and Mont Pelée, which have many points in common. Both volcanoes show a single or practically single vent, and a remarkable absence of parasitic cones and a scarcity of dykes. In both a transverse valley exists to the south of the volcanoes, and the main discharge of ejecta during the recent eruptions, which have often been nearly synchronous, has been into this depression, and especially into its westerly portion. In both islands, the recent eruptions have been characterised by paroxysmal discharges of incandescent ashes, with comparatively few larger fragments and a complete absence of lava.

There are, however, a few points of difference. The eruptions of St. Vincent have been altogether on a much larger scale than those in Martinique. The area devastated was considerably larger, the amount of ashes ejected probably ten times as great, and if the loss of life was not so large, this is accounted for by the absence of a populous city at the foot of the mountain. While both volcanoes show practically a single vent, this is much more marked by the case of St. Vincent, where, excepting the new crater, which is practically part of the old or main one, there is not a single parasitic cone. We saw no fumaroles, no hot springs, or any trace of radial cracks and fissures.

On Mont Pelée, it is true, the main activity is confined to a restricted area about the summit of the mountain, and the top of the great fissure which extends or extended from this down in the direction of the Riviere Blanche; and there are no parasitic cones comparable, for instance, to those which are so numerous on Etna; but there are many fumaroles, which Prof. Lacroix and his colleagues speak of as emitting gases hot enough to melt lead and even copper wire. A telegraph cable has been three times broken at about the same place, and the broken ends on one occasion, at any rate, showed marks of fusion. There are also several hot springs. Judging from these and other indications, it is most probable that radial cracks entered deeply through the substance of the mountain, and penetrated even the submarine portion of its cone.

The local distribution of erupted material in Martinique is accounted for by the great fissure at the top of the valley of the Riviere Blanche, which communicated with the main pipe of the volcano, and out of which the eruptions took place. This fissure, which was mentioned as existing in the eruption of 1851, pointed almost directly towards St. Pierre, and as the erupted material flowed out almost like a fluid, it was directed straight down on the doomed city. The lowest portion of the lip of the crater of the Soufriere was much broader and more even, so the incandescent avalanche which descended from it was spread much more widely.

The latest accounts from Prof. Lacroix indicate that the recent small eruption of Mont Pelée has filled up the highest parts of the fissure and formed a cone, the foot of which covers up the former crater ring. In any further eruption, therefore, the avalanche of incandescent sand will not be confined to the district of the Riviere Blanche, but may descend on any side of the mountain.

The accompanying photograph of Mont Pelée in eruption was obtained from a ten-ton sloop in a sea way and is therefore not quite sharp. Attention was directed to the eruption by a peculiar black cloud which appeared over the volcano and then rolled down the side of the mountain to the sea. The cloud was formed of surging, rolling, expanding masses, in shape much like those of the previous cauliflowers, but quite black, and full of lightning-flashes and scintillations, while small flashes constantly struck from its lower surface on to the sea. The upper slopes of the mountain cleared somewhat, and some big red-hot stones were thrown out; then the triangular crack became red, and out of it poured a surging mass of incandescent material, reminding us of nothing so much as a big snow-avalanche in the Alps, but at a vastly different temperature. It was perfectly well defined, did not at all tend to rise like the previous cauliflowers, but flowed rapidly down the valley in the side of the mountain which had clearly been the track of previous eruptions, until in certainly less than two minutes it reached the sea, and was there lost to view behind the remains of the first black cloud, with which it appeared to coalesce. There and on the slopes of the mountain were doubtless deposited the greater part of the incandescent ash, while the steam and gases, with a certain portion of still entangled stones and ash, came forward in our direction as a black cloud, but with much greater rapidity than before. The cloud got nearer and nearer; it was well defined, black and opaque, formed of surging masses of the cauliflower type, each lobe rolling forward, but not all with one uniform rotation; bright scintillations appeared, some in the cloud itself and some like little flashes of light vertically between the cloud and the sea on which it rested. This was clearly the phenomena described by the survivors in the St. Vincent eruption as "fire on the sea," occurring in the black cloud which overwhelmed the windward side of that island. We examined them carefully, and are quite clear that they were electric discharges. The scintillations in the body of the cloud became less numerous and more defined, and gradually took the form of vivid flashes of forked lightning darting from one part of the cloud to another. When the cloud had got within perhaps half a mile or a mile of us—for it is difficult to estimate distances at sea and in a bad light—we could see small material falling out of it in sheets and festoons into the sea, while the onward motion seemed to be chiefly confined to the upper part, which then came over our heads and spread out in advance and around us, but left a layer of clear air in our immediate neighbourhood. It was ablaze all the time with electric discharges.

FIG. 1.—Photograph of an eruption of Mont Pelée.

As soon as it got overhead, stones began to fall on deck, some as big as a walnut, and we were relieved to find that they had parted with their heat and were quite cold. Then came small ashes and some little rain. The cloud was also noticed at Fort de France. It was described as like those in the previous eruptions, but was the only one in which electric scintillations had been noticed. Two unbiased observers, who had seen it and that of May, declared this was the larger of the two.

As to the mechanism of the hot blast and the source of the power which propelled it, both Dr. Flett and I are convinced of the inadequacy of previous explanations, such as electricity, vortices, or explosions in passages pointing laterally and downwards, or explosions confined and directed down by the weight of the air above. Such passages into the mountain, which, to be effective, would require to be closed above, do not exist in the case of the Soufrière, and we are not aware that they have been observed in Mont Pelée; and as to the weight of the air, this did not prevent the explosions in the pipe of the Soufrière from projecting sand and ashes right through the whole thickness of the trade-winds until they were caught by the anti-trade current above and carried to Barbados. Moreover, the black cloud, as we saw it emerge from Mont Pelée, seemed to balance itself at the top of the mountain, start slowly to descend and gather speed in its course, and the second incandescent dis-

[1] From a discourse delivered by Dr. Tempest Anderson at the Royal Institution on January 23.

charge followed the same rule. We believe that the motive power for the descent was gravity, as in the case of any ordinary avalanche.

The accepted mechanism of a volcanic eruption is that a molten magma rises in the volcano chimney. It consists of fusible silicates and other more or less refractory minerals, sometimes already partly crystallised, and the whole highly charged with water and gases, which are kept in a liquid state by the immense pressure to which they are subjected. When the mass rises nearer the surface and the pressure is diminished, the water and gases expand into vapour and blow a certain portion of the heavier and less fusible materials to powder, or, short of this, form pumice stone, which is really solidified froth, and they are violently discharged from the crater. When the greater part of the steam and gases have been discharged, the lava, still rising, gets vent either over the lip of the crater or often through a lateral fissure, and flows quietly down the side of the mountain.

It is quite recognised that these phenomena may occur in various relative proportions. We believe that in these Pelean eruptions, the lava which rises in the chimney is charged with steam and gases, which explode as usual, but some of the explosions happen to have only just sufficient force to blow the mass to atoms and lift the greater part of it over the lip of the crater without distributing the whole widely in the air. The mixture of solid particles and incandescent gas behaves like a heavy liquid, and before the solid particles have time to subside, the whole rolls down the side of the mountain under the influence of gravity, and consequently gathers speed and momentum as it goes. The heavy solid particles are gradually deposited, and the remaining steam and gases, thus relieved of their burden, are free to ascend.

The effect of avalanches in compressing the air before them and setting up a powerful blast, the effects of which extend beyond the area covered by the fallen material, has long been recognised. A group of large trees was overthrown by the blast of the great avalanche from the Attels on the Gemmi pass in 1895; all lay prostrate in directions radiating away from the place where the avalanche came down.

THE ZOOLOGICAL SOCIETY'S MEETING.

THE monthly meeting of the Zoological Society of London, at their house in Hanover Square, held on January 22, was well attended, it being expected that some account of the operations of the committee of reorganisation recently appointed by the council, on the occasion of the change in the secretaryship, would be given. The chair was taken by His Grace the Duke of Bedford, K.G., the president, at 4 p.m., and the new secretary, Mr. W. L. Sclater (lately director of the South African Museum, Cape Town), was present for the first time. After the election of new fellows and other routine business, the report of the council was read by the secretary. It stated that thirty additions had been made to the Society's menagerie during the month of December last, amongst which was a very fine pair of the one-wattled cassowary (*Casuarius uniappendiculatus*), deposited by the Hon. Walter Rothschild, M.P. The report also stated that the total income of the Society in 1902 had been 29,077*l.*, being, in spite of the bad weather that had prevailed during the summer, only 273*l.* less than the receipts of the previous year, and being the sixth largest annual income ever received by the Society. The report of the reorganisation committee was then read to the meeting by Sir Harry Johnston, K.C.B., the hon. secretary of the committee. It was divided into numerous heads relating to every branch of the Society's affairs, and containing recommendations thereon. Many of these were of a technical character, but important changes were advised under the heads of the gardens and menagerie, the prosectorium, the staff at Hanover Square and the secretaryship. The charge of the Society's gardens and menagerie was proposed to be entrusted to a member of the council, Mr. W. E. de Winton. Mr. de Winton would thus, for the present, take the place of Mr. Clarence Bartlett, who has retired on account of bad health on a pension. This appointment being for a year only would give time for the selection of a new superintendent, who must possess special qualifications such as were not easily to be found. Various buildings, such as the giraffe house, the small mammals' house and the bears' dens, were pointed out as specially requiring reconstruction, and there should be a new seals' pond and better accommodation for the polar bears. Alterations were also recommended at the monkey and antelope houses and in other buildings. A foreman keeper should be appointed to make periodical tours of inspection in the gardens during the day, and the keepers should be forbidden to accept gratuities, to trade in living animals or to keep them without the sanction of the authorities. The prosectorium should be carried on by the present officer in charge (Mr. F. E. Beddard, F.R.S.), but on lines to be laid down by a scientific committee, so that the work should have a more definite object. The prosector should also have a veterinary assistant, who would help in the *post-mortems* and look after the health of the animals in the menagerie. The salary of the new secretary would begin at 600*l.* a year, and his work would be under the supervision of various committees, of all of which the president would be an *ex officio* member. These committees were to be directly responsible to the council. The garden-guide, which the council had formerly granted to the secretary as part of his emolument, had now reverted to the Society, and would be improved and carried on for their benefit.

After the report had been read, the recommendations based upon it and adopted by the council were read from the chair by the president, and it was agreed that they should be printed and sent to the fellows. Notice of a motion was then given by Mr. A. G. Ross that copies of the testimonials tendered to the council by Mr. W. L. Sclater, the newly elected secretary, and by Dr. Chalmers Mitchell (one of the unsuccessful candidates) should be printed and sent to all the fellows. This motion was ordered to be discussed at the next general meeting on February 19.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT Bedford College on Thursday, February 5, a lecture on "Electricity and Matter" will be given by Sir Oliver Lodge.

THE first two scholarships at Oxford granted under the terms of Mr. Rhodes's will have just been awarded by the Government of Rhodesia to two students of the Jesuit College in Bulawayo.

THE award of valuable scholarships by private institutions deserves encouragement. We are glad, therefore, to notice that as a result of the recent scholarship examinations, the board of control of the Electrical Standardising, Testing and Training Institution has made the following awards:—To W. H. C. Prideaux, of Shrewsbury School, a Faraday scholarship, value eighty guineas, tenable for two years; to N. S. Smith, of Wellingborough School, an exhibition, value thirty guineas, tenable for two years; to W. d'Arcy Madden, of Haileybury College, and to Frederick Smith, of Aldenham College, special prizes of ten guineas each.

IT is understood that the Carnegie Trust will shortly take active steps to encourage post-graduate research. The present idea is that with the assistance of the Trust, students, after graduating, will be enabled to prosecute thoroughly their particular branches of study. Mr. Carnegie is reported not to consider suitable the post-graduate organisation of Oxford and Cambridge. His scheme will provide no substantial livings. The amount of fellowships, while ample for adequate study, will not be so large as to induce the possessors to cling to them for a livelihood, and, moreover, the fellows will be selected and not ascertained by competition. The fellowships will be directed mainly into the channels of scientific research. Graduates desiring to become fellows will be required to state the class of research they wish to pursue.

THE annual meeting of the Mathematical Association was held on January 24, Prof. A. Lodge in the chair. The report of the committee appointed by the Association to consider the subject of the teaching of elementary mathematics, to which reference has already been made in these columns, was referred to in the council's report for the past year. Prof. Forsyth was elected president for the forthcoming year, and Mr. A. W. Siddons submitted the report of the committee on the teaching of elementary mathematics, which, he said, had been criticised as very conservative. The most immediate need was that the preparatory schools should move in the matter, and they should get the head-masters of such schools to adopt a more modern treatment of mathematics. It would not be done in the public schools unless the boys were taught from the beginning.